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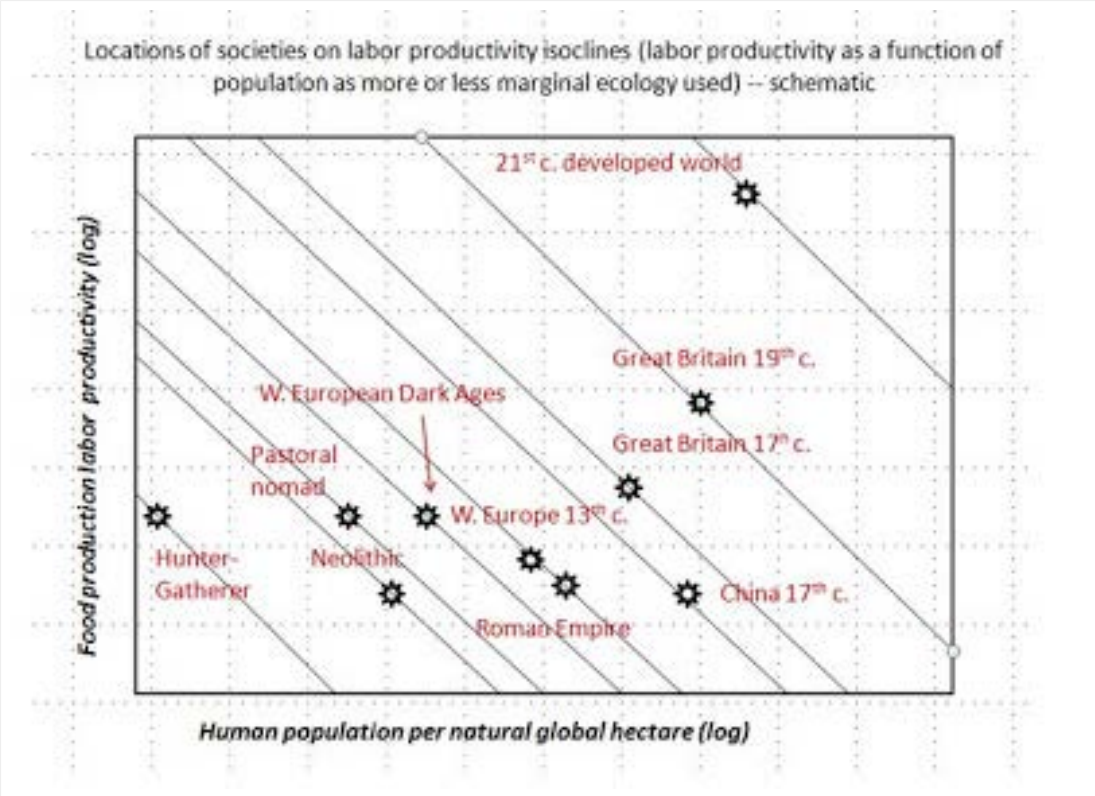
WEITERE INFORMATIONEN OK

An unending variety of topics

Sunday, October 24, 2010

Malthus and capital

Why did agricultural civilization remain mired in the Malthusian trap for over 5,000 years? And how was it possible to eventually escape from it? Recall the Malthusian isoclines and how various kinds of societies can be situated along them (click to enlarge all graphs):



Plagues move the economy "northwest" along the isoclines, as more marginal lands are abandoned leaving the fewer people to work and share the more productive lands. Births beyond replacement by contrast move the economy "southeast" towards higher population, the use of more marginal lands, and thus a lower standard of living. Here, for example, is a graph using actual statistics for English real farm labor wage income from 1260 to 1849. Even though England during this period was slowly escaping from the Malthusian trap -- note that each 80 years has advanced farther "northeast" than the previous 80 -- it still followed the basic Malthusian pattern of births and deaths. Observe how the real wage greatly increased after the Black Plague in the mid-14th

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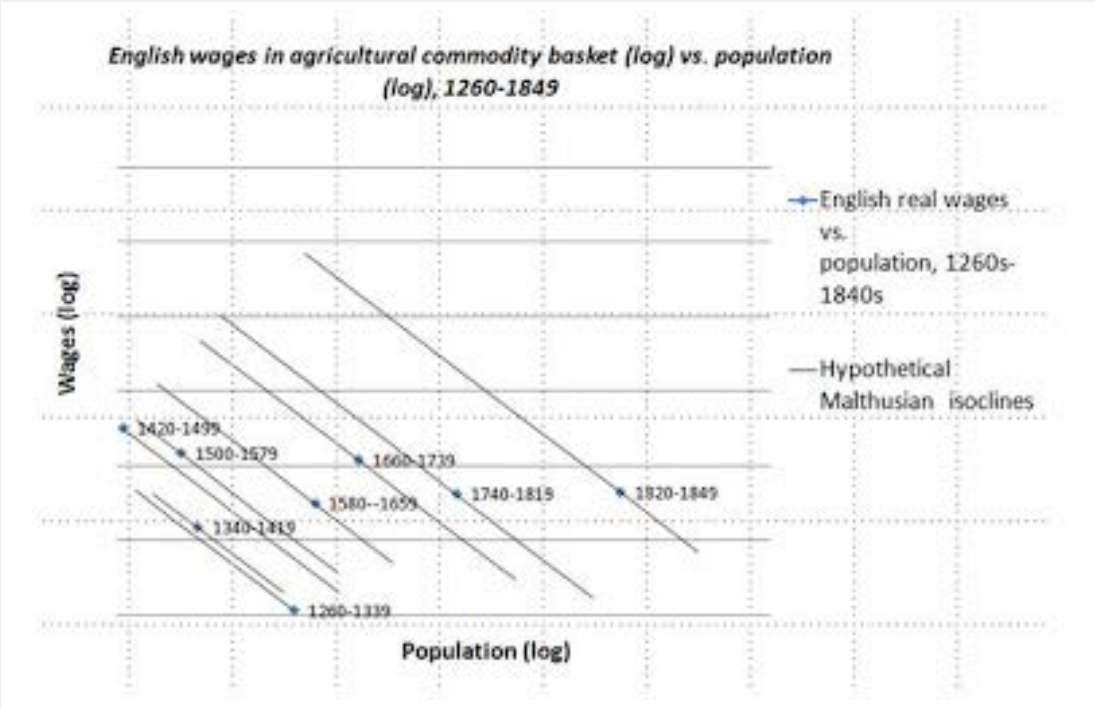
century, then slowly declines thereafter:



Much less well appreciated than the effects of births and plagues with respect to the Malthusian isocline are creation and destruction of productive capital. Every act of plowing, sowing, weeding, and so on was a seasonal capital investment, and the resulting harvest (and thus the short-term isocline) depended on the qualities and quantities of these short-term investments, as well as on vagaries of pests, weather, etc. Longer-term capital investment could include conditioning, fertilizing, and draining soil, buying livestock, breeding crops and livestock, watering meadows, and so on. Long term progress towards the "northeast" depended on long-term accumulation of capital. It was exceedingly rare to maintain such progress over long periods of time, and the British capital accumulation over such a long period, leading to the breakout from the Malthusian trap, was unprecedented.

Good harvests caused progress that was temporary unless the food was stored and long-term capital investment was substituted for investment in next year's harvest as well as other pursuits such as luxury and military buildup. Productive innovation, whether institutional or technological, also led to moving the isoclines "northeast", as they made capital more secure or productive.

Poor harvests (from pests, poor weather, etc.) caused a setback that was temporary as long as it didn't lead to the destruction of capital. If it resulted in starvation, the deaths boosted the economy up the isocline, so that the standard of living of the remaining population in subsequent years of better harvests was higher than with

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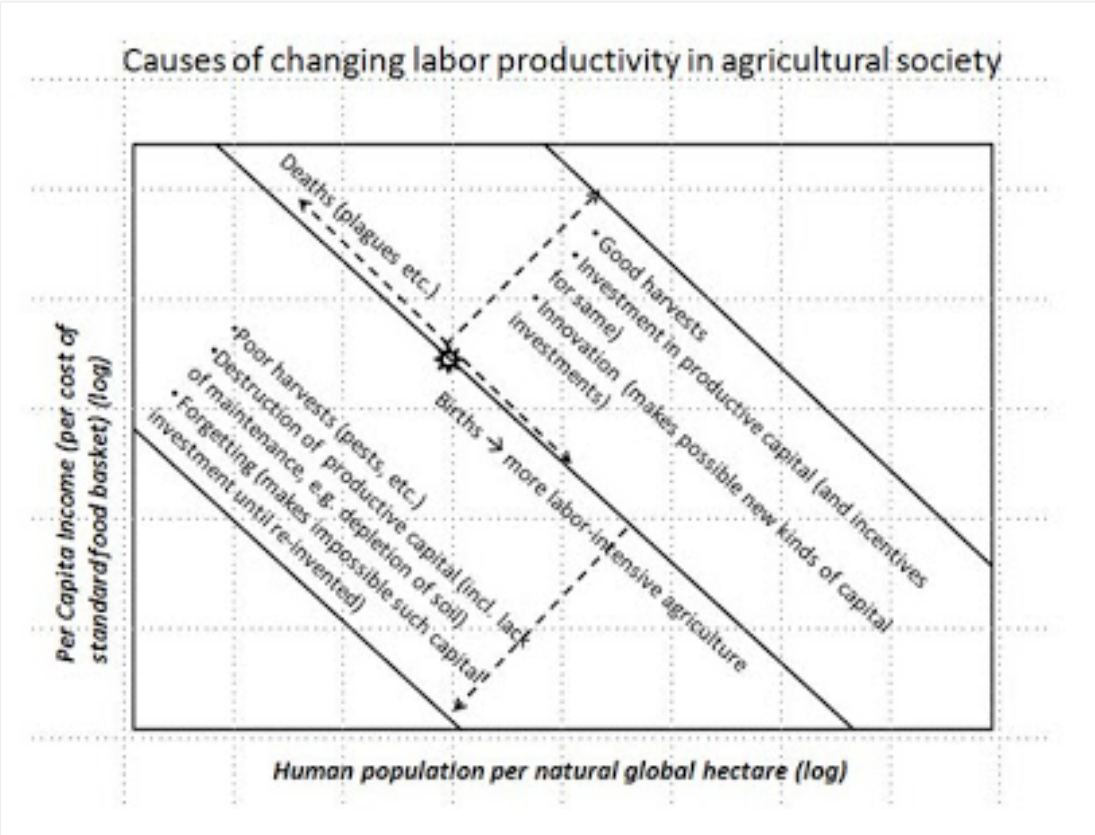


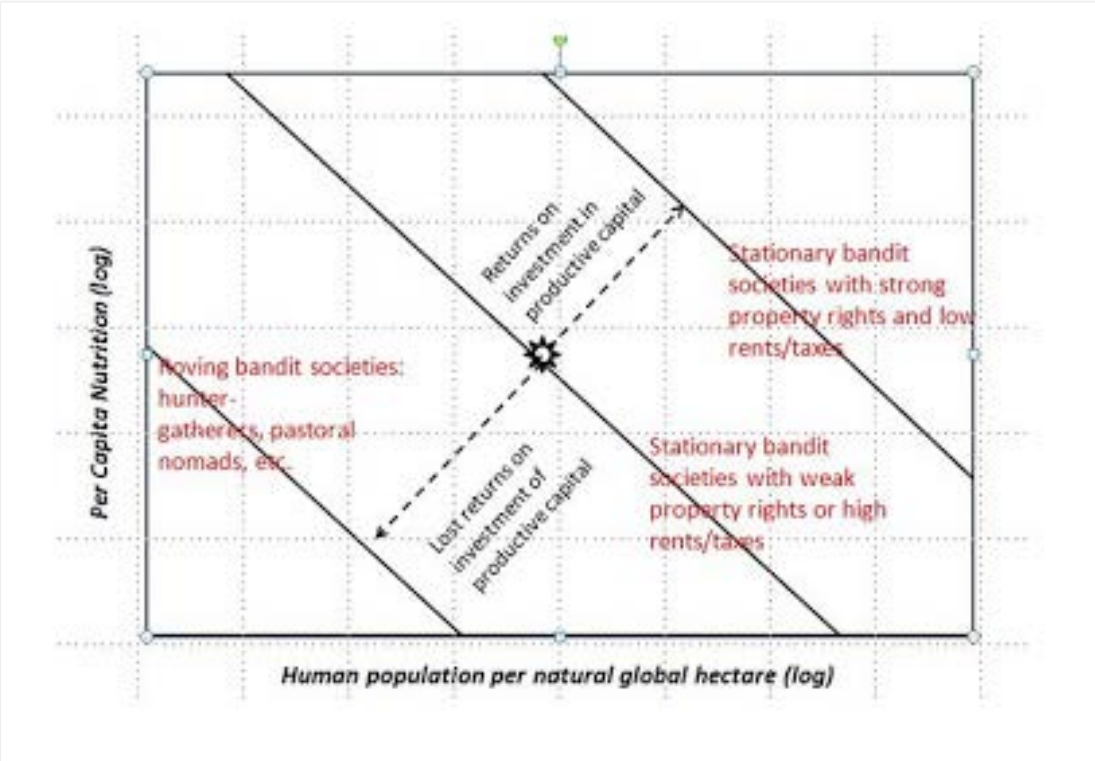
prior better harvests at higher populations.

Destruction of productive capital was for most of agricultural history as common as creation of capital. Causes included high rents and taxes that forced a choice between going hungry and consuming capital. War (quartering and foraging of troops, destruction of enemy crops and livestock, etc.) was a frequent cause of capital destruction. Some kinds of capital, e.g. livestock and the fertility of the soil, could be destroyed simply by being neglected.

Mancur Olson distinguished between societies of “roving bandits”, where nomadic rulers stole the surpluses of foragers or farmers wherever they went, and “stationary bandits”, who controlled a specific area and simply taxed that area. Rational stationary bandits taxed only to the Laffer maximum, because any further taxation actually reduced their revenues. Indeed, because over-taxation resulted in the destruction of capital, a secure rational stationary bandit reduced taxes below the short-term Laffer maximum to prevent lower tax revenues in future years. Roving bandits, on the other hand, stole nearly all, resulting in destruction of nearly all capital, because anything insecure that one roving bandit didsn't steal was stolen by another.

Stationary bandits did not always confine themselves to taxation that resulted in no destruction of capital. Uncertainty over future power could cause a leader to get greedy and tax at capital-destroying levels while they were still in power. Threats of assasination, coup, or conquest could move stationary bandits closer to roving bandits, since the bandits lost their future revenues if they lost power or territory: in such cases they rationally taxed far higher than the Laffer maximum, usually destroying much capital in the process.

As a result, we can characterize societies and locate their isoclines based



on their mode of banditry. This often gets confused with the mobility of production, and the two usually coincided, but they could and often were distinct. Thus most pastoral societies, based on moving livestock from pasture to pasture, also featured roving banditry. And societies based on fixed arable agriculture were generally controlled by stationary bandits. But early modern Britain was a semi-pastoral society but with stationary bandits. And Dark Ages Europe featured roving bandits from pastoral societies frequently conquering arable societies, and being conquered in turn, resulting in a move to a lower-capital society with a mix of roving and stationary banditry.

The Problem of Edible Capital

Of all the ways in which capital can be destroyed, the hardest to avoid, in a hard year, was eating it. Eating your milk cow or your draft animal was like eating your seed corn: very unwise but very likely if your alternative was imminent starvation.

The temptation to eat your capital created vicious cycles of capital destruction. Capital destruction lowered labor productivity, which meant that people produced less calories per calories consumed. This moved the Malthusian isoclines "southwest", which meant even more people starved during the next equally bad year. War and excessive taxation could trigger or extend the vicious cycle by killing livestock, poisoning farmland, etc.– and rendering future returns insecure, rendering further destruction of capital more probable. The vicious cycle of capital consumption during times of famine may be the main factor that kept ancient agricultural civilizations mired in the Malthusian trap.

Who owned the capital mattered. Edible capital was much more likely to survive (and in the short term the starving people less likely to) if the capital was owned by people who were not themselves starving. Thus, societies living under the feudal hierarchy of long-term tenancy, where livestock was often owned by the local lord rather than a peasant, many have maintained themselves farther above subsistence levels than societies where peasants completely controlled their own livestock.

Culture was filled with warnings against "eating your seed corn." Thus, as one example of many, Aesop's stories of "The Goose That Laid the Golden Egg." It was also filled with warnings about the importance of saving up for bad times, e.g. "The Ant and the

Grasshopper."

Conversely, capital creation that increased labor productivity increased the calories produced per calories consumed, moving the Malthusian isocline up and right. With storage of food it also freed labor for further capital creation, which in future equally good years in turn freed further labor for ancillary or non-agricultural capital investment (transportation, manufacturing, financial services, etc.). However, for nearly all of agricultural history the vast majority of this surplus went to population growth, military expenditure, and luxury display rather than capital investment.

Thus, until the British breakout, agricultural societies remained in the Malthusian trap. Prior agricultural socieities lacked an institutional ratchet that could incentivize capital creation in good harvests, but prevent too much capital destruction in bad harvests. And they generally lacked low-cost protection from foreign wars, so that stationary bandits often started to act more like roving bandits when faced with threats of conquest. To escape the trap, capital creation must exceed capital destruction to such an extent that farm labor productivity grows faster than population. How Britain did this I hope to explore in future posts.

Posted by Nick Szabo at 3:33 PM

15 comments:

J Thomas said...

How did the Romans get past the Malthusian thing?

My immediate guess is they did it by taking slaves. The slaves worked for minimal rewards -- but wise slaveowners didn't work their slaves to death too fast. Male slaves were sometimes castrated, female slaves tended not to reproduce. So the population growth rate was limited.

Take land from neighboring lands, enslave their people, more land and more slaves -- no problem.

If there is some problem, a food shortage etc, work the surplus slaves to death and get more when the problem is past.

What went wrong? They ran out of new fertile land? Christianity got in their way? They ran into Goths etc who were logistics experts, who could assemble a city quickly and move it just as quickly? All the usual suspects....

But feudal landlords didn't castrate their serfs or keep the women from getting pregnant. So -- malthusian trap.

I have no backup for any of this but sheer prejudice, but it sounds plausible to me. ;)

And I'd guess that a necessary part of getting out of that was power sources other than muscle. While it was limited to human or ox power, there wasn't a whole lot extra people could do. Particularly when some fraction of the labor went into stonework fortresses and cathedrals. (What fraction? I dunno, prejudice says maybe it was significant.)

Kings who could knock down stoneworks had an incentive to improve roads so their siege engines etc could move faster. That was a capital improvement. Etc.

And imperialism had multiple advantages. Get a lot of men out of the country, so they didn't eat as much at home. A lot of women who didn't marry. Some food coming home from colonies. Which was the most successful empire? Britain.

It all fits together so easily when you ignore facts....

4:46 AM

Leonard said...

I think you are onto something in evaluating England as unique in terms of its incentives for quality of government. This all gets back to one thing: water. The English Channel. For any enemy to have to take ships across a substantial body of water to invade makes securing the primary property much easier. It's also just different: you need a navy, not an army (and that may have its own effects; certainly navies are a capital investment in a way that armies are not). But at the same time, water was the roads then. So England could still be closely linked to trade networks, and to idea networks.

It does seem like these things should be possible to find evidence for. I.e., in expenditures on standing military, in trade records, and by analyzing how quickly new ideas from outside got to England, as versus anywhere else.

8:24 PM

nick said...

J. Thomas, the Romans didn't get past the Malthusian trap. While a tiny fraction of their elites, as with many empires, became very wealthy and built many spectacular monuments, their large populations of slaves and high-taxed peasants had low standards of living (as I've shown on the graph). Their Malthusian isocline was higher than, e.g. Italy before or after the Empire, which given the mean standard of living was about the same meant their population was higher than before or after. Their more advanced isocline was probably due to better security of property, especially compared to the later Dark Ages. But also important was having an extensive trade and transport of grain around the Mediterranean, which between the early Empire and the fall of the Western Empire they'd largely freed of pirates. They could transport grain from areas of surplus to areas of shortage across a very wide area, which land-locked or broken up governments could not do. Once these sea channels (and the road network that was its necessary complement) deteriorated, so did their Malthusian isocline. (I'll have more to say about the crucial role of transportation in future posts). Stationary bandits that weren't replaced by roving bandits came to act more like roving bandits, the isocline regressed further, and Western Europe deteriorated into its Dark Ages.

The British Empire was far more a consequence than a cause of what Britain did to break out of the Malthusian trap, as I hope to detail in future posts. Note in the diagram above their isocline is already making in percentage terms dramatic progress in the 15th and 16th centuries, long before they'd developed an empire. One important point to note is that, while foreign trade was important to its overall economy, Great Britain actually didn't import more than a small fraction of its food until the latter half of the nineteenth century. Indeed, if we count the fact that it exported a great deal of wool and wool goods, it was a net exporter of agricultural resources from the Middle Ages until well into the 19th century, by which time they were much more an industrial than an agricultural economy and could easily pay for the food they imported with a small fraction of their manufacturing exports.

Leonard, I briefly touched on Great Britain having a superior security of property due to its geography here and here (hopefully the second link will be up again soon).

Great Britain's "moat" was necessary but not sufficient -- they also needed relative political peace between the various cultures and factions on the island, low rents/taxes on productive capital investment, laws that protect property, and the ability to make agricultural innovations sufficient to take enough advantage of their greater security of capital investments. All the protection from foreigners is pointless if the local politicos destroy your capital anyway.

10:00 PM

Leonard said...

That first link was a good read. (2nd is not yet in evidence.) Sometime perhaps I ought to make time to read your archive.

Somewhat off topic, but at the end of the linked piece you wonder about the barrier between hunter-gatherers and farming. I have read somewhere the hypothesis that taming dogs might have been a key event in the advent of agriculture. A dog's territorial instinct solves the fundamental problem of primitive anarchy: no property.

Back on topic, although I agree that protection from foreigners is pointless if the local politicos destroy your capital, I rather thought the point you made in the original piece is that the incentives facing the local politicos determine what they will do. ("Determine", on average over the long run.) So the moat might cause, or at least be a significant cause of, the stuff you mention (political peace, low taxes, good property law, and innovation). Peace is the health of the people.

12:43 PM

J Thomas said...

Nick, I have no intention of collecting data and looking at sources of bias in the data etc. So I will defer to your superior knowledge.

I certainly agree about transportation by sea, and also note that fertilizer was a big deal. If you export a lot of food, then you need to import a lot of fertilizer, but that didn't happen? So places like Egypt that got their fertilizer from outside naturally, could keep growing crops for export for centuries where some other cropland would go bad in a relatively few years.

10:30 PM

nick said...

Leonard, if there was such a thing as a competitive market for security, lower security costs would straightforwardly translate to lower taxes/rents. It certainly makes such lowering possible and more likely than if security costs are high, which I suspect is what I vaguely had in mind when I wrote that. But instead of a free market there was a hierarchy of rent-collectors, and figuring out how much of the security cost savings they'd pass on to their largely immobile farm tenants, rather than spending on luxuries (e.g. extra domestic servants) and rent-seeking is a subtle matter, which I've by no means at this point mastered. Albeit, since a central part of my thesis is increasing mobility, perhaps another benefit of mobility is that the serfs and peasants became not quite so immobile after all and rents relative to farm profits declined after all. It's well known that rents rose substantially, due to inflation (conquistadors with their well characterized flood of gold and silver) and (less well characterized) per-acre productivity increases, but the question is whether farm profits were rising faster than rents, allowing more to be plowed back (so to speak!) into capital investments, and how the difference between (before-rent) profits and rent compared to other countries. Alas, while we have good numbers for rents, we don't have good stats for farm profits. Albeit more important than physical mobility would have been alienability, i.e. the freedom to move from one farm to another. Interestingly enough, leases were getting shorter term by the 16th century, so that's definitely worth exploring.

J. Thomas, fertilizer was indeed a big deal (my article on the nitrogen crisis was a warmup :-) Also soil conditioners like lime that reduced the acidity of the soil, making uptake of these nutrients easier and greatly reducing aluminum poisoning. And better nitrogen fixing plants. Which meant more fodder, which meant more horses, which then hauled more lime and pumped out deeper coal mines and lifted and hauled more coal to more places, which burned lime into a powdered form that could de-acidify the soil. All working together in virtuous (positive feedback) cycles to push Britain's isocline far northeast long before the recognized "industrial revolution" or the most popular dating for the "agricultural revolution." Call it the Agricultural Evolution.

1:34 AM

nick said...

BTW, credit where due dept., E.A. Wrigley and Eric Kerridge developed many of the ideas I am discussing (Wrigley in at least a broad way wrt horses as a source of farm work increasing farm labor productivity, Kerridge wrt progress in pre-18th-century farming techniques) and wrote about it in their own way. Clark, Overton, and many others have studied versions of the Malthusian real wage (or per capita nutrition) vs. population graph. Langton studied the slow substitution of horses for oxen in late medieval England and remarked on the benefits of horse transport in expanding trade. I seem to be the first to have recognized the lime/horse/coal

virtuous cycle and the monotonic increase in Britain's Malthusian isocline after at least 1260. The convential wisdom is lack of clear progress before 1800 and magical transformation to rapid progress after that time, resulting in a quixotic search for a magic bullet at the end of the 18th century. But that comes from looking at too short time intervals, which when plotted look like noise. To see the monotonic progress before 1800 one needs to look at 80-year timespans or longer to minimize exogenous natural variations in harvests (e.g. variations in weather and pests).

J. Thomas' comment on Egypt is apropos. The Nile spring flood provides a number of crucial things. Water in a desert, obviously. But also good old NPK (nitrogen, phosphorous, and potassium). And possibly soil conditioning. As it happens, the Brits were clever enough to make their own little Niles: "floating the watermeadows", i.e. diverting early spring rain-choked streams and their effluvia into otherwise dry hay meadows with a sophisticated set of ditches: restoring NPK (on top of some nitrogen already being provided in the meadow by vetch or clover). And other interesting surprises. For example little known to researchers of the "agricultural revolution", who've searched in vain for a magic bullet around the magical year of 1800, they did indeed import a crucial fertilizer starting in the early 19th century, and of course the more well-known fertilizer imports at mid-century and thereafter, as well as inventing the first artificial fertilizers. But the Agricultural Evolution had a good head of steam far sooner than that. Probably even by the 15th century, judging by the movement of the isocline, although records about what specifically they were doing are alas rather poor until near the end of the 16th. (Kerridge thinks most of it was invented in the 16th and 17th centuries, but some of that is probably selection bias -- that's when farmers were first starting to become literate and writing extensively about their farms).

Speaking of Agricultural Evolution, another interesting development was breeding better horses based on the availability of unnaturally rich amounts of fodder. Thus, for example the gigantic draft horses: the Suffolk Punch, Shire Horse, the Norman Percheron (recall that Normandy was ruled by England during most of the late Middle Ages, or perhaps we could say vice versa since the Normans were the ruling class of England), and of course the Scottish Clydesdales now of Christmas beer-ad fame. Beer was indeed one of many products these horses hauled. That, AFAIK, exhausts the area of origin of the large draft horse breeds (please correct me if I've missed any), demarcating the centrality of Britain to the A.E. that pulled humanity out of the Malthusian trap.

1:40 AM

Leonard said...

Nick, I agree that it requires competition to reliably translate security savings into investment. Certainly, a lord who correctly gauged things and dropped rents with an eye towards increasing productivity in the long run would benefit, but that would stay local. But competition can arise both from labor mobility and "firm" mobility. In this case, if it was possible to sell an estate (as it was for at least some of them), then we should expect that over time, all salable estates would come to be owned by landlords who were low taxers. Also, another aspect of this would be in the development of marginal land; presumably it would not happen in those places with higher rents. So development would tend to increase the usable land in the hands of the lower-rent owners, without any actual land sales.

On the matter of horses, breeding better ones is obviously an important technological development. Draft horses must have a higher power output to feed input than normal horses. I looked around wikipedia and although it does seem draft horses are "easy keepers" (a term I've never seen before), there's no quantification of that.

On the matter of transportation, one technology of some interest may be distillation, which appears to have become widespread in England at about the right time. So one thing you might be able to find are stats on average liquor consumption.

10:46 AM

nick said...

Leonard, assuming fully secure property rights, AFAIK a decrease in the lord's costs doesn't change the revenue maximizing rent, either short or long term, unless there is competition between lords for tenants. Without such competition, lords would make more profits by pocketing all the cost savings. I don't see how the lord's ability to sell estates (alienability) changes this.

Mobility of tenants can change it, because it turns local monopolies into a more competitive market for tenants. So we need the

combination of lower security costs _and_ competition for mobile tenants for the security costs to be passed through to tenants.

The above assumes fully secure property rights, but another effect might make the outcome you are arguing for work: the threat of being conquered. Rulers who fear being conquered are likely to act more like a roving bandit, preventing accumulation of capital or even destroying capital in order to preserve their realm's future revenues for themselves. A move from a more roving-bandit-like Laffer curve to a stationary bandit Laffer curve would lower the Laffer-maximum rent/tax rate for territorial monopolies, so in that case we'd see rent lowering even without increased mobility of tenants.

11:23 AM

nick said...

BTW, your distillation comment has me puzzled. How did transportation benefit from distillation before the IC engine? Perhaps roadside inns and the hip flask made road travel tolerable in the era before shock absorbers? :-) I guess I don't see the connection you are trying to make.

11:29 AM

Leonard said...

Nick, I was not assuming fully secure property rights. However, even with that assumption, there is still a tradeoff of long-term vs short term profit, which is not a matter of rationality but preference. (Specifically, time-preference.) A lord who liked wine, women, and song might be expected to tax more, and thus lower the value of his estate (or not raise it as fast as others do).

In any case, the security of property is never known to be absolute since it is the future being evaluated. So, there is room for even the most rational long-term profit maximizers to differ.

Your third para was really more what I was thinking: some of the lords would be thinking in terms of being a roving bandit, some of them would think of being a stationary bandit. Assume this does not only reflect time-preference, but prediction. Then some would be wrong, some right. Which would profit most (and thus given enough time, come to dominate alienable estates) would depend on what future actually happened. And this is where peace would be good -- it would tend to favor the stationary bandits.

As for the effect of distillation, think of it as reducing the weight of grain by 90%, and making it spoilage-proof, and it should be clearer. (90% is purely autorectal; I am sure the actual number could be estimated pretty well though.) Given *any* transportation, it means you can transport 10x as much at a given cost. Thus, there is a means by which grain grown in productive but distant areas can nonetheless enter the market. (This is marginal land in a sense, but a different kind of marginality than land that simply is not very productive.) Thus, it should tend to make exploitation of marginal land more profitable.

5:10 PM

Eric Johnson said...

I think the water content of grain is much lower than 90%; closer to 12%:

http://www.ag.ndsu.edu/pubs/plantsci/crops/ae905w.htm

Some kinds, at least, will keep for some years, but I don't know if all will. I don't know whether holding them for years requires any processing that would not otherwise be done.

Also I would suspect that making durably well-sealed barrels for fluid is a good deal more laborious than making sacks or boxes for granular solids.

Staves had to be planned for smoothness on the outside and slightly cupped inside. The Bevel on their edges must be precise or they

would neither fit together nor hold water. Also the tapering of each stave is critical to its fit. Hoops were made by the local blacksmith. (Earlier barrels were made with wooden hoops.) Staves were soaked so they could be curved properly. Some barrels were burned inside while others might be sealed with glue or pitch. Any that were to be used for food storage, needed to be relatively airtight (tight cooperage) so sealing material would not contaminate foodstuffs. "Slack cooperage" refers to containers that were not tight but would be fine for flour, grains and other non-liquids.

Further labor could be required for fermentation and distillation.

11:35 PM

Borscht said...

You'd get too drunk to do farmwork long before you'd get enough calories to do farmwork.

2:24 PM

Luke Lea said...

Bob Allen, an economic historian at Nuffield College, Oxford, has spent his life studying these questions. He writes clearly, and most of his stuff is available on-line.

http://www.nuffield.ox.ac.uk/General/Members/allen.aspx

His lecture notes on Malthus are towards the bottom.

7:17 PM

nick said...

Thanks for the pointing us to Robert Allen. He's been looking at many of the same questions I've been looking at, and it's fascinating comparing our methods and conclusions.

11:05 PM

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